DISASTER-FRIENDLY LOW-COST HOUSE-BUILDING MANUAL

DWELLING IN RIVER FLOOD VULNERABLE AREA

CARITAS BANGLADESH
House # 02, Outer Circular Road
Shantibagh, Dhaka 1217
BANGLADESH

Disaster-friendly Low-cost House-building Manual

Relevant to River Flood Vulnerable Area

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PREFACE

Caritas Bangladesh commenced its disaster management program and initiated relevant activities to serve the disaster-affected community in the background of cataclysmic November 12, 1970 Cyclone and Storm Surge in the southern part of the country as well as to respond to dire needs of millions affected by nine-month long 1971 Bangladesh War of Liberation.

Bangladesh is one of world's most disaster-vulnerable areas on account of its geographic location. Natural hazards like flood, flash flood, cyclone, storm surge, drought, river-bank erosion, landslide, etc., cause immense human casualty, crop failure and property loss almost every year, affecting the poor and low-income people. General public are very much affected and distressed on account of house collapse leading to troublesome accommodation problem in the wake of such disaster occurrence. Poverty and poor earning prevent average people from building and owning strong and well-built house, and this hard fact results in damage and destruction of their dwelling options following moderate wind and/or water in-flow.

Caritas Bangladesh identified this housing problem as far back as 1985 and has been on the move since then to find out practicable way out. It adopted a "Low-cost Housing" pilot project in 2010 following the 'evaluation of low-cost housing assistance' project undertaken earlier in 2007 to serve the families distressed by November 15, 2007 Cyclone SIDR. Low-cost houses were constructed during 2010 in cyclone-prone Kalapara upazila (sub-district) under Patuakhali district and flood-prone Sirajdi Khan upazila (sub-district) under Munshiganj district to provide relief to disaster affected families.

Eventually in 2012-14 following adequate experiment, study and observation, a pilot project titled Low Cost Housing (Pilot LCH) was taken in hand under financial assistance from Secours Catholique–Caritas France and Caritas Luxemburg. Prime aim and objective of the Project was evolving viable design and strategy towards construction of low-cost sustainable and disaster-friendly house according to hazard types in disaster-vulnerable areas of Bangladesh as well as to encourage and motivate the poor community at risk to accept and pursue them; Caritas utilized technical assistance in this respect from Bangladesh University of Engineering and Technology (BUET) and CRAterre France.

Mainstreaming Disaster Friendly Low Cost Housing (MDFLCH) project was subsequently undertaken for the period of 2016-18 under financial assistance from Secours Catholique – Caritas France. As part of the project, Caritas developed as many as 35 structural designs compatible to disaster-friendly and sustainable house construction in view of hazard types and hazard-risky area; BUET and CRAterre France provided necessary technical assistance in the exercise. To promote the issue further, 105 disaster-friendly and sustainable low-cost model houses were constructed according to these designs in 20 unions of 20 upazilas under 17 districts within 08 dioceses of Caritas Bangladesh.

Later, Disaster Management Committee members at union and ward level and Asrayon Task Force members within MDFLCH project area, project staff and BUET teachers visited the model houses time to time; they utilized these fact-finding visits to reflect on such relevant aspects as various designs, building pattern, local culture, easy availability of building materials in the locality, cost, etc.

Pertinent house-building aspects in consideration of threats and risks associated with flood, flash flood, cyclone and storm surge, river-bank erosion and drought vulnerable areas of Bangladesh were well discussed and duly analyzed at field, regional and national level to develop 'low-cost and sustainable house-building Instruction Manual' involving 10 construction steps. Workshops were organized at regional and national level in order to fine tune the issue and finalize 05 (five) low-cost house-building Guide Books to serve the purpose of the dwellers living in fore-noted five hazard-vulnerable areas.

Plane lands in central and northern Bangladesh are widely inundated every year in the wake of river water-flow from Indian states of Assam, Tripura, Manipur and Meghaloy across country's border. Such natural occurrence extensively damages and destroys dwelling places and surrounding in addition to crops, livestock and other necessary goods and assets. This Manual has been prepared with low-cost flood-friendly house design for these areas. Development workers of local and national level Non-Government Organizations (NGO) including Caritas Bangladesh, local government agencies and local artisans and masons can resort to this manual to easily assist poor and hazard-risky community to construct low-cost dwelling place.

Disaster Management Sector of Caritas Bangladesh in cooperation with its eight Regional Offices had to put in extensive work and diligent effort to develop this Instruction Manual. Secours Catholique–Caritas France and Caritas Luxemburg provided financial assistance and Bangladesh University of Engineering and Technology (BUET) and CRAterre France offered technical assistance. We are sincerely grateful to all of them. We are equally grateful to International Federation of Red Cross and Red Crescent Societies (IFRCS) to allow us to utilize 15 (fifteen) of their suitable pictures for the Manual: (Cf. Session-1 Pic.10; Session-2 Pics.13 & 20; Session-4 Pic.53; Session-8 Pics.75, 76, 77, 78, 79, 80, 81, 82 & 83; Session-9 Pics.84 & 85).

The Manual refers to the building materials compatible to hazard-risk reducing construction and prescribes the requisite strategy. We are convinced that proper training of the construction labour force as per the Manual, involvement of the people to its purpose and construction of hard and strong house in the disaster prone area in accordance with its guidelines will make for minimal damage and loss in disaster aftermath. We also firmly believe that this Manual will capacitate the poor community living in the flood risk vulnerable north-east and south-eastern zones of Bangladesh to build low-cost, flood-friendly, sustainable as well as safe and comfortable house.

To conclude, changing and advanced technology and variation in hazard pattern will necessitate modification and re-edition of the Manual in view of time-to-time reflection and observation, and we will do the needful accordingly. Valuable advice and opinion of the Readers and Users of the Guide Book will be attached due importance during re-editing process.

Feancis Atul Sarker
Executive Director
Caritas Bangladesh

Session I

Subject: House Layout
(First Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To explain formation of the Layout of a disaster-resilient house and actually form a layout. 2. To pin-point the area, type and set-up of the Layout and mention the advantages and disadvantages thereof. 3. To describe the disaster risk reduction aspects while formulating the Layout and apprise others accordingly.
Time	75 Minutes
Methodology	Lecture, Discussion, Event recounting, Question-Answer, Experience sharing, Picture display and Drawing.
Materials	Board, Poster Paper, Marker, Flip Chart, Scale, Tape, Rope, Thread, Bamboo Pillar, Cudgel, Spade, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will seek participants' view/opinion about layout, rationale behind layout, layout drawn in their dwelling place, which points / issues are considered relevant to site selection during construction of a house. 2. Following participants response, s/he will expose them to issues for consideration in respect of house site selection through relevant picture(s) by way of flipchart/multi-media; he will also provide handout/sample picture(s) to them.
	Step-III:Time-25 Minutes Facilitator will take the participants in the field and impart practical lesson on layout setting.
	Step-IV:Time-10 Minutes Facilitator will point out to the participants what disaster risk reduction aspects need to be considered in setting the layout.
	Step-V:Time-10 Minutes Facilitator will seek participants word on the following as part of evaluation process through question-answer: 1. Facilitator will attempt to fathom participants understanding of layout, how and where to draw it, its necessity, advantages and disadvantages, imperatives, etc. 2. S/he will explore their perception of which disaster risk reduction issues are relevant for consideration while drawing a layout. Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; s/he then will wrap up the session with vote of thanks

Facilitator's Guide

(House Layout)

Layout of a House refers to its location/situational aspect and its construction formula. Appropriate layout allows adequate light and wind ventilation in the house, makes for homestead beauty, minimizes storm wind pressure and ensures slender possibility of plinth collapse.

Following issues warrant due consideration to determine house Layout:

Area: Total area of a house should measure 18'x10'-6" + 6' in view of SPHERE Standard and normal house-building calculation in rural Bangladesh. Such area is determined to consider and accommodate living space, provision of guest and family conference point, storage of household materials, personal privacy of women, girls, elderly persons and persons with disabilities, etc.

Location: South-faced main door of the house ensures adequate light and wind. Because of geographic location, Bangladesh features wind flow from south-western corner for better part of the year. On the other hand, wind flows here from north-east side during winter. As a result, sufficient light and wind are available in the house with comparatively cool atmosphere during summer, and conversely, house is quite warm and humid during winter.

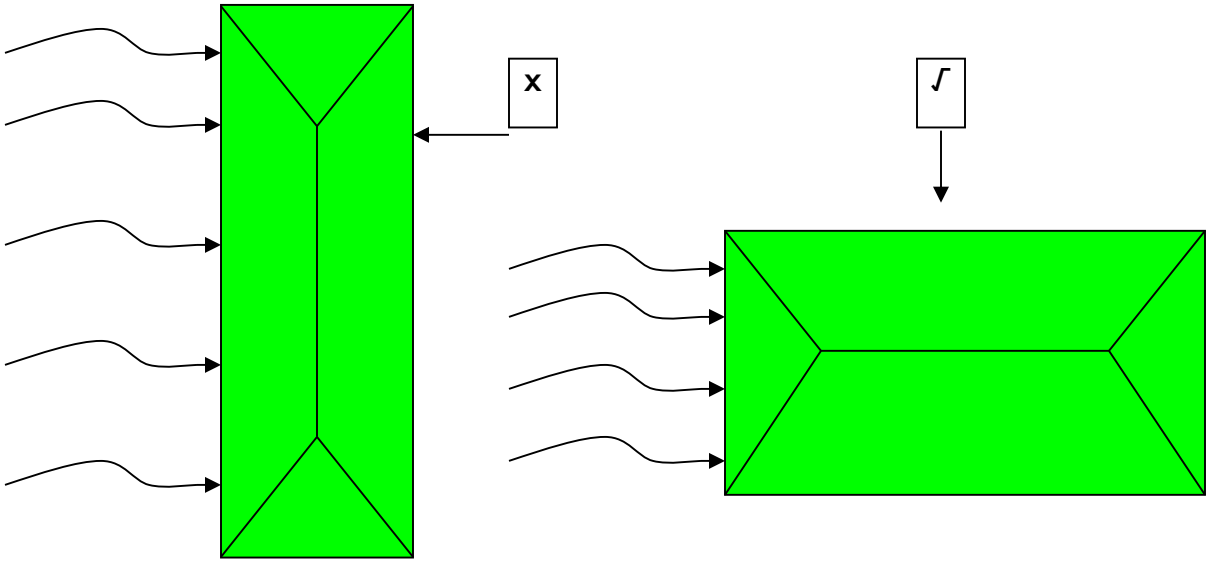
It is better and advisable to provide for kitchen, water source and latrine as close to the house as practicable for the safety of women, girls and children as well as for convenience of elderly and persons with disabilities. It should be ensured that water source point and latrine ought to be at least 30 feet apart; they can however be closely situated where sanitary latrine is provided with septic tank.

There should be provision of proper sewerage and drainage for the sake of healthy and pollution-free atmosphere around the homestead.

Neighbours should be consulted to know their advantages and disadvantages while marking out the precinct of the house; this makes way for peaceful coexistence in the area.

Layout Cost: Estimated **BDT500.00** to **BDT1,000.00**

Pictures depicting issues/matters relevant to Layout drawing

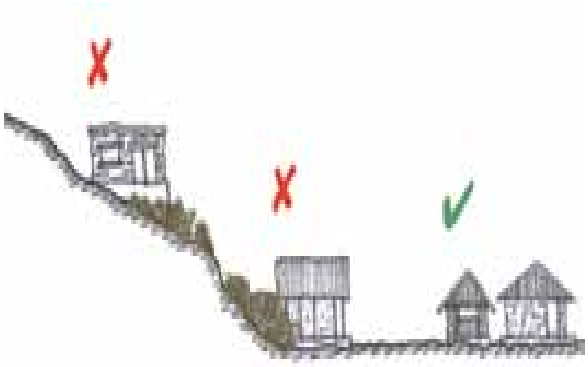


Proposed and Discouraged House Design

Picture 1: Breadth of the house should be in the direction of wind ingress/in-flow so as to minimize the wind pressure and lessen the possibility of house blown-off

Pictures 2 and 3: Constructing house adjacent to pond or canal or river is very risky

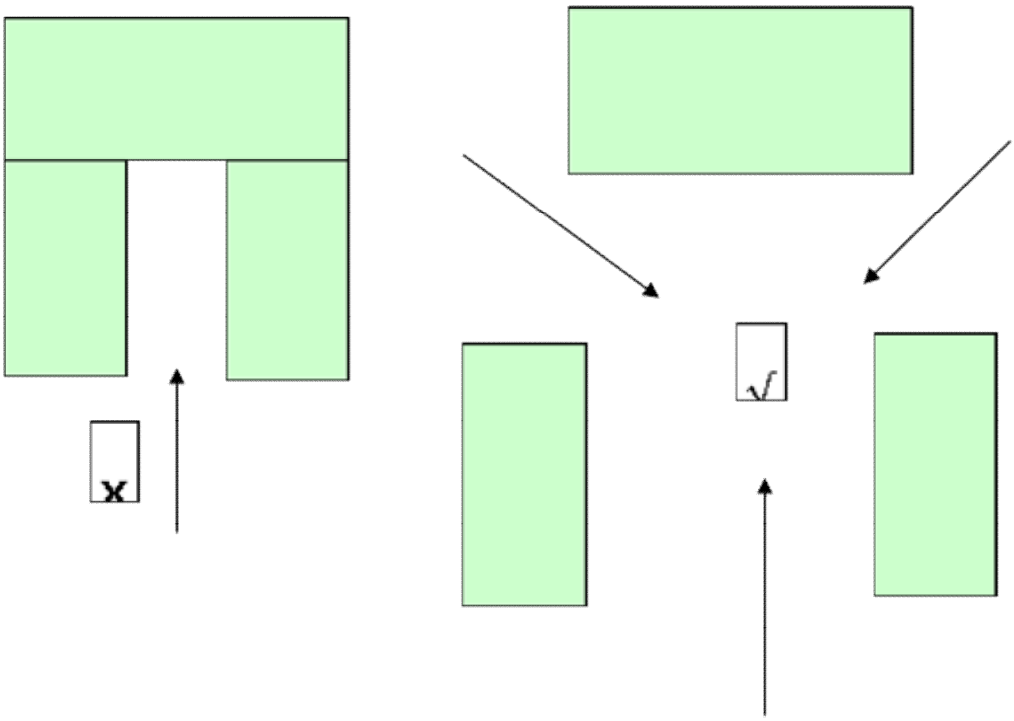
Pictures depicting issues/matters relevant to Layout drawing



Pictures 4, 5 and 6: Constructing house in hill slope is very risky

Picture 7: House plinth/floor should be at least 450 mm or 1'-6" height than the flood/storm surge water level to reduce risk	Picture 8: Constructing house in flood / storm surge vulnerable area involves the risk of water ingress inside house

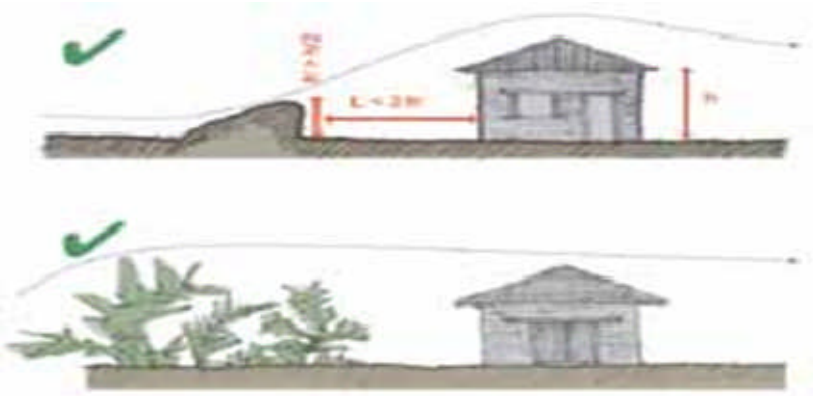
Pictures depicting issues/matters relevant to Layout drawing



Picture 9: Drawing layout with provision of sufficient wind passage as above allows adequate wind and light inside and reduces air pressure

Pictures 10 & 11: Provision of Latrine at 30 feet distance from the house in northern or western side keeps the house stink free

Pictures depicting issues/matters relevant to Layout drawing



Picture 12 Tree plantation at suitable distance in the vicinity of the house makes for minimum storm wind-slash leading to lesser risk of house collapse; tree plantation is imperative to withstand/contain wind-slash (Sketch Credit:IFRC)

Picture 13: House construction in safe distance discounts the risk of house collapse through tree-falling

Picture 14: House construction in unsafe distance involves the risk of house collapse through tree-falling

Session II

Subject: Foundation of the House
(Second Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define various types of Foundation, foundation of low-cost disaster-resilient house as well as its importance. 2. To name necessary building materials and describe construction strategy in relation to Foundation of low-cost disaster-resilient house. 3. To reflect on the relevant aspects of disaster risk reduction while engaging in house Foundation and inform others accordingly. 4. To co-operate with others in working out the Foundation of low-cost disaster-resilient house according to noted design.
Time	75 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing, Picture/Model display and Drawing.
Materials	Foundation Model, Multi Media (if available), Module, Board, Poster/Brown Paper, Marker, Leaflet, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session, at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-30 Minutes 1. Facilitator will discuss about definition of foundation, various types of foundation, foundation of low-cost disaster-friendly house and its importance by way of picture/model display and/or drawing on board or brown paper in view of the handout. 2. S/he will narrate about foundation worked out through brick, RC stone, RC pillar, soil/clay, etc., and its implementation. S/he will later display model or picture of each foundation and hold discussion through question-answer; locality focus foundation and its implementation process should however gain priority in the discussion.
	Step-III:Time-20 Minutes Facilitator will refer to the benefit of foundation and explain the drawback of a weak foundation; s/he will then discuss about maintenance of foundation, construction deadline and cost. He would ensure that the discussion is not one-way and that the participants can raise questions.
	Step-IV:Time-10 Minutes Facilitator will apprise the participants which matters/issues need to be considered to reduce disaster risk during foundation work; s/he will utilize handout and might display picture or model to that end.

Session Conduction Process (Contd.)	**Step-V:Time-10 Minutes** Facilitator will seek participants perception on the following as part of evaluation process through question-answer: 1. What is foundation? 2. What materials are required during foundation work? 3. What are the benefits and drawbacks of foundation? 4. What issues deserve consideration to reduce disaster risk during foundation work? Facilitator might be required to reiterate point(s)/issues as he deems appropriate for the sake of participants clarity; s/he then will wrap up the session with vote of thanks.

Tip for the Facilitator

The Facilitator is required to consult various books, reports, updates, etc., relating to this topic apart from the module in order to gain clear concept of the subject matter; he might also try to collect any other relevant case-study to bolster his perception.

Facilitator's Guide

(House Foundation)

Foundation

Foundation is the base on which house is erected. Overall weight of a house is transformed into underground through foundation. Foundation has to be on hard compact soil as per appropriate design/sketch/drawing. Otherwise, weight of the house might subside house-soil underground leading to crack/rupture/breakage in wall, pillar or any portion of the housing gears. Foundation is thus considered as very essential part of the house.

Characteristic Detail

1. Breadth of a house is generally found to be large or small in consideration of the weight or load borne by wall and pillar.

2. Foundation depth generally differs in view of the height of the house, disaster perspective and local custom/practice.

3. Possibility of house tremor, leaning and blown-out due to storm can be overcome if pillar is dug at least 1'- 6" feet deep inside the hard soil and T-shaped plate is set below the pillar.

4. Foundation is to be interwoven with required number of anchors, otherwise wind might blow away wooden gears.

Construction Strategy

1. Foundation base ought to be at hard compact soil layers.

2. There should not be any foundation work at artificially filled-in soil layers. Even if foundation base is worked out at artificially filled-in soil layers, it has to be strong and hard as per appropriate foundation design.

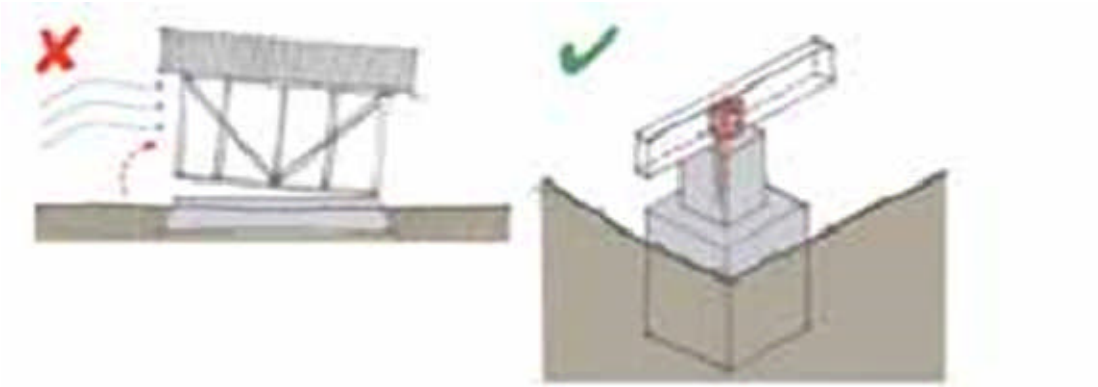
3. The pillar has to be dug at least 1'- 6" feet deep inside the hard soil (through a Paddle used by Bangladesh Rural Electrification Board, if required); the hole is to be compacted with a blending of hard soil, sand, brick chips, stone chips, etc., to prevent pillar's movement.

4. Bottom portion/layer of brick-wall and pillar foundation hole needs to be hardened through hammering.

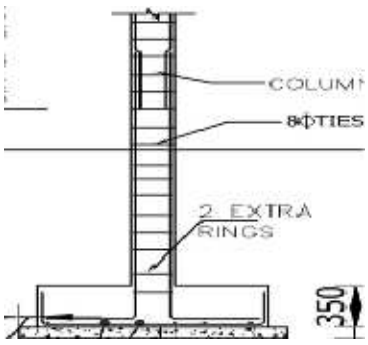
5. Foundation place has to be filled-in hard and hammered with compacted soil or sand after pillar setting.

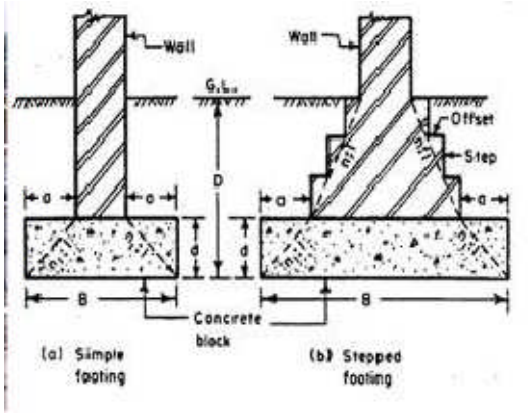
6. Provision of appropriate measure like drainage has to be there to prevent water accumulation at foundation base. .

Pictures depicting issues/matters relevant to Foundation Work

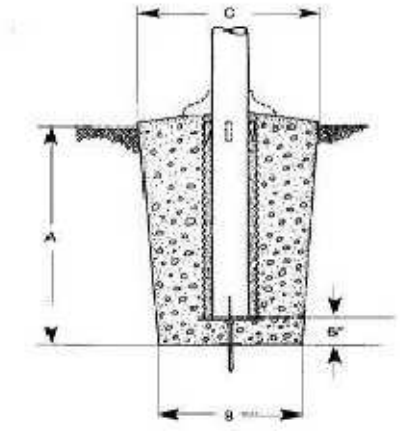


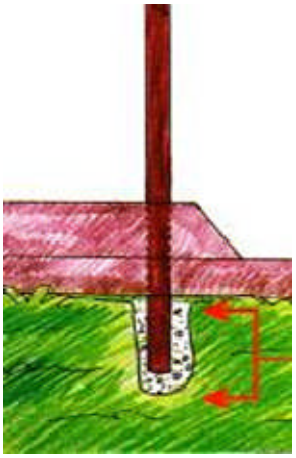
Picture 15: Required number of anchors should accompany the foundation (Sketch Credit: IFRC)





Picture 16: RC column foundation	Picture 17: Brick-work foundation





Picture 18: RC pillar foundation	Picture 19: Wooden pillar foundation

Comparative Advantages and Disadvantages of various types of Foundation

Foundation Detail	Advantages	Disadvantages
Bamboo/Wooden Pillar Foundation	Comparatively less costly	Less sustainable/Less strong
	Locally available	Scarcity of mature bamboo
	Skilled Artisan is not required	Vulnerable to insects or woodworm
	Easily repairable	
RC Pillar Foundation	Sustainable/strong	Comparatively costly
	Do not bend easily	Skilled Mason is not always available
	Comparatively more disaster resistant	Comparatively hard to repair

Advantages

House will not bend and wall will remain crack-free as long as hard soil layers will form its foundation with depth and width according to stipulated design.

Disadvantages

1. Cost is comparatively higher.

2. Skilled artisans/masons are required.

3. Accumulation of water at foundation base will slide it downwards causing wall-collapse and leading to life damage and property loss.

Maintenance

Corroded/washed out clay at the foundation base should regularly be replaced by quality soil, hammered/hard-pressed as well as smeared and polished.

Estimated Cost of Foundation (18' feet x10'-6" feet plus 6' feet width balcony)

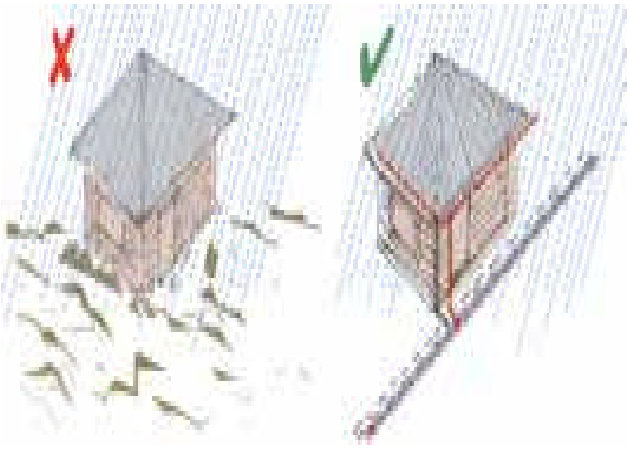
Bamboo/Wooden Pillar Foundation

Sl. #	Work Item	Amount in (BDT)
1	Earth cutting, hole boring and soil pressing involving 02 Labourers	800.00
2	Mixture of brick chips and sand for strong foundation	1,200.00
	Grand Total	**2,000.00**

RC Pillar/Stone Pillar Foundation

Sl. #	Work Item	Amount in (BDT)
1	Earth cutting, hole boring and soil pressing involving 02 Labourers	630.00
2	Stone collection, stone-soil mixture	3,360.00
	Grand Total	**3,990.00**

Pictures depicting issues/matters relevant to Foundation Work



Pictures 20 & 21: Accumulation of water at foundation base causes soil erosion / corrosion weakening the house; provision of appropriate measure like drainage has to be there to prevent water accumulation at foundation base (Sketch Credit: IFRC)

Pictures 22 and 23: Foundation base ought to be within strong soil layers; subsiding base results in crack in the wall

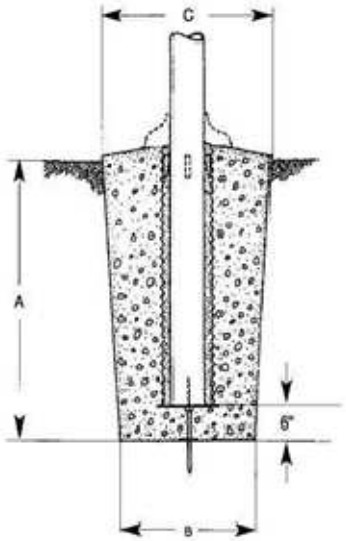
Pictures depicting issues/matters relevant to Foundation Work

Picture 24: Specimen of a sound plinth

Picture 25: Pillar insertion at least at a depth of 1'-6" feet in strong soil forestalls any chance of house leaning

Picture 26: Pillar insertion in strong soil at less than a depth of 1'- 6" feet retains the possibility of house leaning

Pictures depicting issues/matters relevant to Foundation Work



Picture 27: If wall layers are combined at 6 inch height over the courtyard, water cannot creep into the wall

Picture 28: Bangladesh Rural Electrification Board uses such Paddle/Spud

The pillar has to be dug at least 1'-6" feet deep inside the hard compact soil (through a Paddle as used by Bangladesh Rural Electrification Board, if required); the hole is to be compacted with a blending of hard soil, sand, brickbats, stone chips, etc.; eventually, pillar will have no scope of movement.

Session III

Subject: Plinth of the House
(Third Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define Plinth of the house construction and learn its importance. 2. To learn various types of house Plinth, their respective features, advantages and disadvantages. 3. To come across the strategy and process of constructing disaster Plinth. 4. To describe disaster risk reduction matters/issues while constructing a Plinth and apprise others accordingly.
Time	75 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing, Picture/Model display and Drawing.
Materials	Foundation Picture/Model, Multi Media (if available), Module, Board, Poster/Brown Paper, Marker, Leaflet, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session, at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-30 Minutes 1. Facilitator will discuss about definition of plinth, various types of plinth, plinth of low-cost disaster-resilient house and its importance by way of picture/model display and/or drawing on board or brown paper in view of the handout. 2. S/he will display model or picture of each type of plinth and hold discussion on implementation of various types of plinth through question-answer; house plinth common in the locality and its implementation process should however gain priority in the discussion.
	Step-III:Time-20 Minutes Facilitator will refer to the benefit of plinth and explain the drawback of a weak plinth; s/he will then discuss about maintenance of plinth, construction deadline and cost. S/he would ensure that the discussion is not one-way and that the participants can raise questions.
	Step-IV:Time-10 Minutes Facilitator will apprise the participants which matters/issues need to be considered in respect of disaster risk reduction during plinth work; he will utilize handout and might display picture or model to that end.
	Step-V:Time-10 Minutes Facilitator will seek participants word on the following as part of evaluation process through question-answer: 1. What materials are required to construct a plinth? 2. What are the various ways of plinth maintenance? 3. What issues matter in respect of disaster risk reduction while constructing a plinth? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; s/he will wrap up the session with vote of thanks.

Facilitator's Guide

(House Plinth)

Plinth

Plinth is a very important and indispensable part of a house. The space between the courtyard level and floor of the house is plinth. Plinth might take various designs or forms depending on house type, disaster perspective in the area, local custom/practice, etc. For example, plinth formed by mixture of soil and other elements, brick-built plinth and stone-based plinth, etc. People in some area again are accustomed to bamboo or wooden platform as plinth as part of their culture.

Characteristic Detail

1. Plinth type is determined by local custom/practice, practice and availability of materials.

2. Length and breadth of the plinth measures at least 0.0'-0.6" feet larger than that of the house for the sake of sustainability.

3. Plinth height is determined in consideration of house location, hazard aspect and local custom; in addition, the height is at least one feet more than the normal flood or water-logging level to stave off or reduce water submergence.

4. Mould of plinth soil is smeared with one or the other of dry *binya* grass (a special type of grass), damaged paddy, dry straw, hardened grass, paddy husk, etc., depending on availability, in order to ensure strong and crack-resistant plinth.

5. Plinth is made sloppy with provision of steps to make it strong. Plinth height determines its slope and steps; generally 2-3 steps.

Pictures depicting various types of Plinth

Picture 29: Earthen plinth

Picture 30: Stone-based plinth

Picture 31: Brick-built Plinth

Picture 32: Localized Platform House

Earthen Plinth

Construction Strategy

1. Mould of plinth soil is smeared / polished with one or the other of dry *binya* grass (a special type of grass), damaged paddy, dry straw, stiff grass, paddy husk, etc., depending on availability, in order to ensure strong and crack-resistant plinth.

2. Earthen mould has to be prepared along with ring-wall encircling the house and floor space to be filled-in before finalizing the plinth. Earth filling up to 0.0'-0.6" feet layer along with hammering/hard-pressing of the soil is an effective deterrent to floor subsidence and crack.

3. Extended portion of the roof has to be so extended as rain-water pouring down the roof lands 0.0'-0.6" feet afar from the plinth, thereby preventing any damage to the plinth out of rain-water.

Time-frame

Six Labourers would need to engage for three days to complete earth-filling of 1'- 6" feet height plinth and floor measuring 18' feet in length x 10'-0.6" feet in breadth along with a balcony.

Advantages

1. Plinth strengthens overall structure of the house.

2. Required soil/clay forming the plinth along with mixing materials is locally available.

3. Landlord can equally engage in plinth work.

4. Application of any of (i) dry *binya* grass (ii) damaged paddy, (iii) dry straw, (iv) stiff grass, (v) paddy husk to plinth soil results in lesser fissure/crack in the plinth, reduced soil erosion as well as prevents damp/humidity and adds to sustainability.

5. Plinth structured with requisite rungs is comparatively stronger than normal general plinth.

6. Plinth with attached steps is well-neigh immune to damage from rain-water; only the lower step might however be affected if and when circumstances turn unfavourable. Besides, rungs/steps can be repaired without much hassles at minimum cost when damage occurs; plus, overall management cost and labour charges are meagre..

Disadvantages

1. Green grass, dry straw, etc., tend to suck out earthen plinth, crack might result in the process; white ant might also be damaging.

2. Plinth is vulnerable to rat-hole.

Maintenance

1. Plinth has to be smeared/treated with cow-dung at least once a month; frequency might vary according to locality.

2. Washed away and/or eroded and/or hole-affected areas of the plinth must be filled-in forthwith, to be followed by hammering/hard-pressing and smearing / polishing.

3. Vegetables, crop items, dry fish, etc., should not be stored / preserved on the plinth floor to avoid any direct contact.

4. Rat menace must be addressed in no time.

Pictures depicting issues/matters relevant to Plinth Work

Picture 33: One Step is provided in the plinth where its height from the ground level equals one feet

Picture 34: One-and-a-half feet height from the ground to plinth level calls for two Steps

Picture 35: Where height from ground to plinth level is more than one-and-a-half feet, three Steps are warranted

Picture 36: One inch slope is generally provided in case of one feet height

Pictures depicting issues/matters relevant to Plinth Work

Pictures 37 and 38: If and when one or the other of dry *binya* grass (a special type of grass), glued/sticky paddy, dry straw, stiff grass, paddy husk, etc., is smeared/polished with the mould of plinth soil, depending on availability, plinth gets strong and crack-resistant

Picture 39: Earthen mould has to be completed along with ring-wall encircling the house and the floor space has to be filled-in with appropriate soil before finalizing the plinth. Earth filling at 0.0'-0.6" feet layer with severe hammering of the soil proves to be an effective deterrent to floor subsidence and fissure/crack	Picture 40: Additional portion of the roof has to be so extended that rain-water pouring down the roof lands 0.0'-0.6" feet afar from the plinth, thereby preventing any damage to the plinth out of rain-water

Pictures depicting issues/matters relevant to Plinth Work

Picture 41: Use of green grass, dry straw, etc., tends to suck out earthen plinth, crack might result in the process; white ant might also be damaging.	Picture 42: Rats might bore holes inside the plinth.

Picture 43: Rain-water mark; plinth topsoil has been washed away. ,	Picture 44: Specimen of a cracked plinth.

Picture 45: Roof should have 0-6” feet extension beyond the house fence or wall	Picture 46: Plinth has to be smeared / coated at least once a month; frequency might vary according to locality.

Brick Work Plinth

Brick-built plinths are common in water-logged, flood vulnerable and *haor* (wetland ecosystem) area of Bangladesh, because earthen plinths are unsafe and weak in the face of water in-flow. Besides, brick-built plinths are sustainable and protective against underground theft, apart from adding to social status.

Characteristic Detail

1. Five-inch brick-built plinth is prepared for nine-inch high plinth.

2. Ten-inch brick-built plinth is better to prepare nine-inch to two-feet high plinth; a combine of ten-inch and five-inch bricks’ plinth may however be an alternative option in the light of the design in order to reduce cost.

3. Brick-built plinth utilizing a combine of ten-inch and fifteen-inch bricks may be used in case of two-three feet high plinth as per design.

4. In respect of plinth in *haor* / wetland and saline water area, entire outer part of the brick-built plinth should be well plastered with net-cement finishing; net-cement finishing should go down six inch deep underground .

Picture 47: Defective design results in crack in the plinth.	Picture 48: There can be brick-built plinth for a part of plinth area, vulnerable to rain-water sprinkles, avoiding the whole plinth area; this would minimize cost to some extent.

Pictures 49 & 50: Mud mixture can be applied to the plinth as a measure to minimize cost; but in that case, there has to be a pointing through blending cement with sand.

Construction Strategy

1. Brick-work will start with well watering first grade bricks. First grade bricks are not susceptible to breakage if dropped down from chaste-height position after setting them cross-wise (lengthwise and diagonally) one above another. First grade bricks will be of copper colour and must be smooth and even in shape.

2. Brick chips will have to be suitably blended with cement and sand according to required proportion, later to be watered; and this mixture must be put into use within one hour.

3. Thickness of masonry joint in brick plinth must not be less than 12mm and more than 20mm.

4. Masonry joint must be in the middle point of each brick; however joint would have to be one-fourth in respect of 10” inch brick-work.

5. Masonry must be completed per appropriate plumb-line

6. Sand required in masonry has to be well strained so as to sieve out any unwanted and damaging particle.

7. Joints have to be well cleaned after work.

8. Saline water and salty sand must not be applied in mason-work and plaster.

9. Curing will follow for at least seven days after 24 hours of masonry and plastering work.

Advantages

1. Brick-built plinth is generally hard and strong.
2. It does not get damp.
3. Strong and hard plinth lasting 20-25 years.
4. Labour and management cost of the plinth is meagre.
5. Plinth is immune to crack.

6. Underground theft is not possible.

7. Not vulnerable to damage by rat.

Disadvantages

1. Too much costly.

2. Excessive use of bricks results in environmental pollution.

Maintenance

1. Immediate repair in case of any damage.
2. Outer part of the plinth should be black-painted.
3. Immediate repair to make up soil erosion in the base.

Time-frame:

Six labourers will have to engage for four days to complete brick plinth and earth filling of the floor of a house measuring 18' feet length x 10' feet breadth x 8' feet height.

Estimated Cost to construct a Brick Plinth of 8' height along with a balcony:

Item Detail	Quantity	Unit Cost (BDT)	Total Amount (BDT)
First grade Brick	1,325 Ea	12.00	15,900.00
Sand	46 Cft.	30.00	1,380.00
Cement	05 Bags	500.00	2,500.00
Earth Filling	03 Labourers Wage	-	2,220.00
		Grand Total	**22,000.00**

One might decide to have brick-built plinth only in the plinth side facing substantial rain-water sprinkles, avoiding the whole plinth area, so as to minimize cost.

Comparative Cost of different types of Plinth

Plinth Detail	Budget (BDT)
Earthen Plinth (18' feet length x 10.5' feet width=385cft)	4,500.00
Earthen Plinth with balcony (18' feet length x 16.5' feet width=545 Cft.	5,500.00
Plinth prepared with Ferro-cement (complete with earth filling)	15,000.00
Brick-built plinth (complete with earth filling)	22,000.00

Session IV

Subject: Pillar of the House
(Fourth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To explain about different types of Pillar of the house and its importance. 2. To explain about construction strategy of different types of Pillar and their costing. 3. To explain about advantages, disadvantages and maintenance of different types of Pillar. 4. To learn about low-cost disaster friendly Pillars and inform others in this respect. 5. To explain the disaster risk reduction points/issues to be considered while constructing and installing a Pillar
Time	85 Minutes
Methodology	Lecture, Discussion, Question-Answer, Event/Experience sharing, Picture/Model display and Drawing.
Materials	Board, Poster Paper, Chalk/Marker, Picture, Model, Handout, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-20 Minutes 1. Facilitator will gradually discuss about the pillar of the house through model and pictures (Pictures 1,3 etc.) in the light of the handout; like, importance of the pillar through lecture and question-answer, nature and importance of various types of pillars through model and picture display.
	Step-III:Time-25 Minutes Facilitator will gradually explain the construction strategy and cost of the pillar, their advantages, disadvantages and maintenance; he would ensure that the discussion is not one-way and that the participants can raise questions. As to construction strategy and cost of the pillar, s/he will draw and write down accordingly on the board; if necessary, he will read out from the handout and utilize suitable model or picture. S/he will additionally explain about advantages, disadvantages and maintenance through picture display
	Step-IV:Time-15 Minutes Facilitator will apprise the participants which matters/issues need to be considered to reduce disaster risk during pillar construction and installation in the light of the handout.

Session Conduction Process (Contd.)	**Step-V:Time-15 Minutes** Facilitator will seek Participants word on the following as part of evaluation process through question-answer: 1. What is a pillar meant for? 2. What is its necessity and importance? 3. What about Its construction strategy and cost? S/he would seek to fathom participants perception of the entire subject, and would explain again around the grey area, if any. Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks.

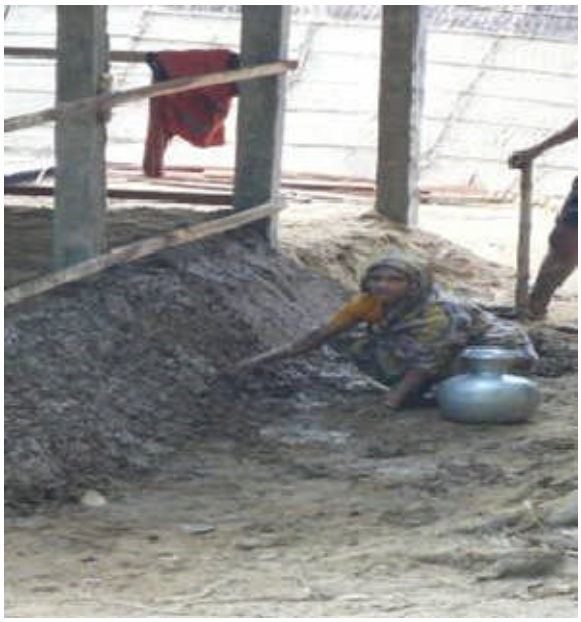
Pillar

House roof in rural Bangladesh is usually set over wooden pillar or bamboo pillar or RC pillar or brick wall. Weight of the roof is thus transferred onto the earth, a linkage between house and earth is established and effectiveness of the house structure is thereby ensured.

Scarcity of mature wood, insect/worm attack, pillar decay/decomposition at the base, maintenance cost, etc., substitutes RC pillar on the large scale for the wooden pillar

Picture 51: Termite affected wooden pillar

Picture 52: Insect-affected wooden pillar triggered by earth contact



Picture 53: Use of RC pillar in rural area is on the rise

RC Pillar

Characteristic Detail

- Length of the Pillar of the main house should generally be 10’ to 12’ feet and section – 5” inch x 5” inch or 4” inch x 4” inch.
- Length of the Pillar of the balcony should generally be 9’ to 10’ feet and section – 4” inch x 4” inch.
- Four 10 mm dia vertical MS Rod; 08 mm dia Stirrup or Ring every 06 (six) inches (according to sketch/picture).

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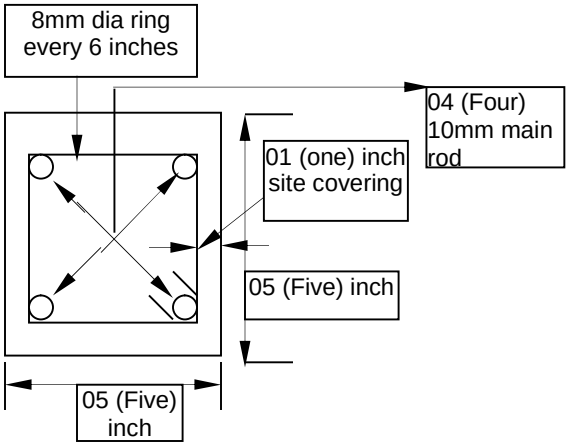
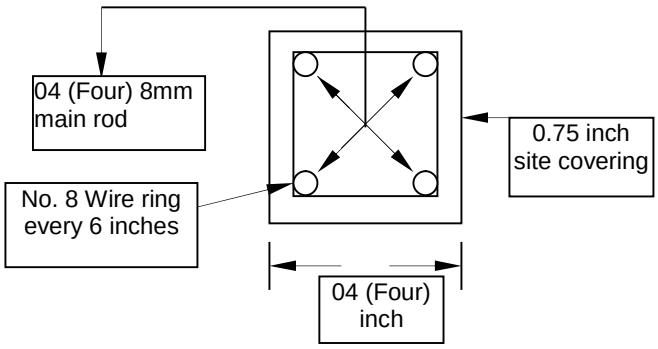
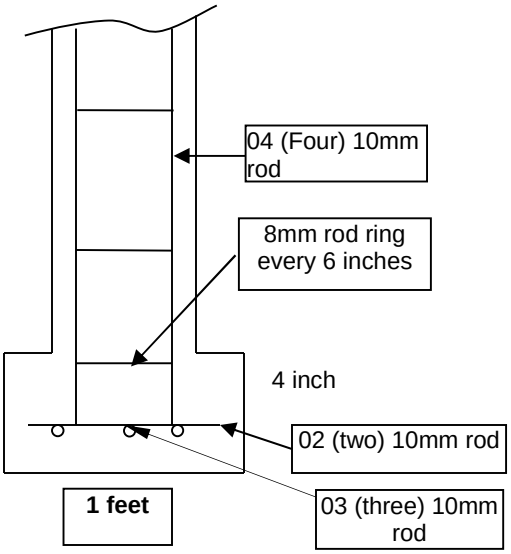


Graphics. 54: One RC Pillar section



Graphics. 55: One 04 (Four) inch RC Pillar section



Graphics. 59: One vertical column section

Construction Strategy

1. Cement, sand and stone-or-brick chips are to be blended at 1:2:4 ratio; to be mixed later with concrete applying proper amount of water, so that the blended product does not get thin.
2. Half inch down-grade brick chips are to be applied.
3. Sand and brick/stone chips are to be properly filtered in a strainer.
4. Thick sand has to be properly filtered before use in casting so as to sieve out any iota of stone, dust or rubbish inside; as because, fine sand must be free from dust/rubbish.
5. Brick and stone chips must be well washed prior to blending.
6. The pillar has to be dug at least 1'- 6" feet inside the foundation/base (using a Spud/Paddle utilizing rural electricity, if necessary). The hole has later to be compacted with hard soil, sand, brick-chips, stone-chips, etc. so as to avoid any movement of the pillar.
7. Pillar has to be dug vertically through plumb-line, so that it does not bend.
8. Pillar has to be perforated so that fence bonding, or door/window frames and corner bracing can be properly set
9. Roof frame has to be strongly tied with RC pillar top using additional rod, nut, bolt, etc., to prevent the roof from being blown away by wind/storm surge.
10. Pillar mould/forma should well be watered or coated by heated Mobil before casting.
11. Pillar mould/forma should be removed 16 hours after casting.
12. Pillar's edge must not be sharp.
13. Sweet water should be utilized for pillar's casting and curing, invariably not saline water; and the water ought to be free from straw, grass or leaves.
14. Curing should span at least over a period of 14 days.
15. Proper covering of the structure of rod(s) is to be ensured before casting/at the time of shuttering.

Time-frame for Preparing RC Pillar

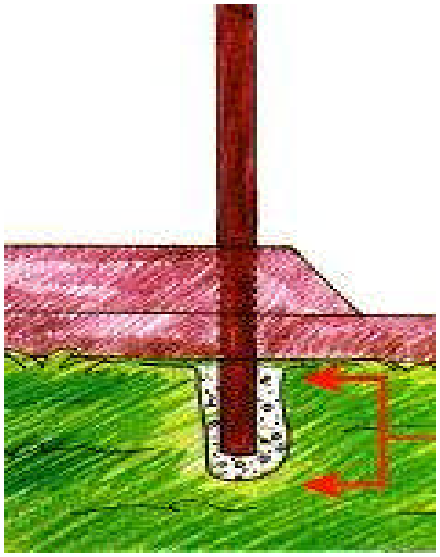
One mason in association with an attendant can very well complete casting of four to five pillars per day along with fastening rod and shuttering.

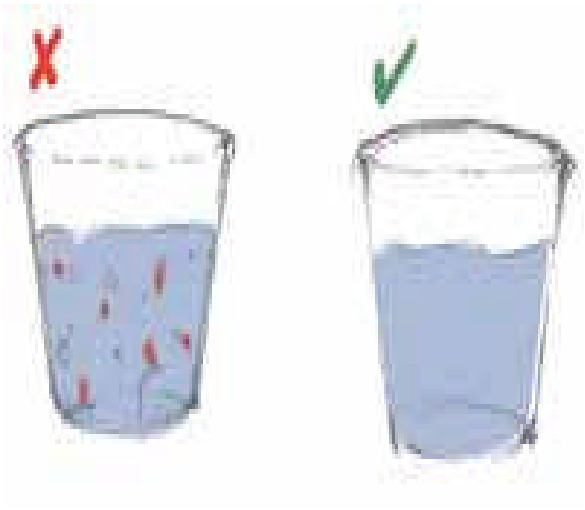
Cost

Item Detail	Quantity	Unit Cost (BDT)	Total Amount (BDT)
10" long Pillar of 5"x5"	4 Ea	1,400.00	5,600.00
12" long Pillar of 5"x5"	4 Ea	1,700.00	6,800.00
Grand Total			**12,400.00**

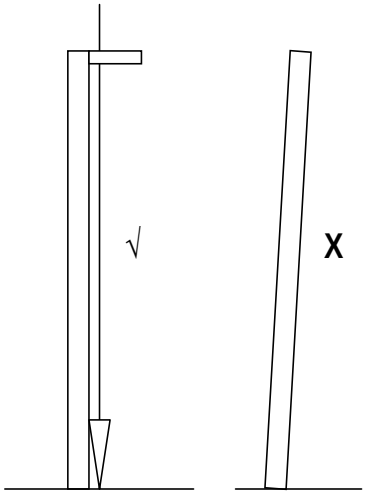
Note: Term "*Ea*" or "*Each*" is a standard unit for any countable item from materials management perspective

Pictures depicting issues/matters relevant to preparing RC Pillar





Picture 57: The Pillar has to be dug at least 1'- 6" inside the foundation/base. The hole has later to be compacted with hard clay, sand, brickbats, stone-chips, etc. so as to avoid any movement of the pillar.	Picture 58: Drinkable water is to be used while casting pillar. (Sketch Credit: IFRC)



Picture 59: Pillar has to be dug vertically through plumb-line so that it does not bend.	Picture 60: Pillar has to be perforated so as to properly set fence bonding, or door/window with sheath and corner bracing.

Pictures depicting issues/matters relevant to preparing RC Pillar

Pictures 61 & 62: Roof frame has to be strongly tied with RC pillar top using additional rod, nut, bolt, etc., to prevent the roof from being blown away by wind/storm surge.

Picture 63: Cement, sand and stone-or-brick chips are to be blended at 1:2:4 ratio; to produce an RC Pillar

Advantages

1. RC Pillar is stronger than, and can withstand/absorb more wind pressure in comparison to, bamboo/wooden pillar.
2. It can last 15-20 years, if properly prepared.
3. Its repairing is hardly required.
4. It is less costly compared to mature wood.
5. Requisite construction materials are locally available.

Disadvantages

1. RC Pillar might develop crack and succumb to salinity, if its covering is not appropriate.
2. Its transportation might be problematic because of its weight.
3. It cannot be elongated in future.
4. Its fitting and fixing with house roof, bracing and fence are difficult in comparison to wooden pillar.

Maintenance

Painting of RC pillar at the base ensures its immunity against saline water.

Pictures depicting issues/matters relevant to preparing RC Pillar

Picture 64: RC Pillar might develop crack, succumb to salinity and get damaged, if its covering is not appropriate

Picture 65: Painting of RC pillar at the base ensures its immunity against saline water

Picture. 66: Its transportation might be problematic because of excessive weight

Bamboo Pillar
(*Borak*-a local variety)

Product of Bangladesh, availability of local materials and incurring minimum cost dictate maximum use of mature bamboo pillar to construct earthen/clay house.

Characteristic Detail

1. House pillar is generally 09'-12' feet length with 3"-4" inch dia.
2. At least three-year old mature bamboo is used to avoid worm-attack; and yellow colour at the bamboo joints confirms its three years maturity
3. Bamboo of borak / baijjya / vailka variety is utilized as house pillar.

Construction Strategy

1. At least three-year old straight mature bamboo is utilized as house pillar.
2. Bamboo for pillar should be gathered from bamboo garden during Bangla months of *Falgun* and *Choitra* (corresponding to mid-February to mid-April) of the year; mature bamboo ought to be cut off from the garden before appearance of new leaves.
3. Pillar has to be dug at least 1'-6" feet deep inside the indigenous original earth/clay.
4. The hole has to be well compacted following insertion of the pillar.
5. The pillar has to be dug vertically to prevent any tendency to lean down.
6. There has to be a groove atop the pillar so as to well fasten the frame; groove/sheath is to be carved slightly above the pillar-joint
7. Bamboo for pillar has to be dried up for 07 (seven) days following collection from the source. It has to be drenched under pond/canal/river water at least for 03 (three) weeks and later dried again for seven days before ultimate use. Seven-day dried pillars are long-lasting and immune to worm-attack; This process is termed 'seasoning' or locally branded as pannet / painally
8. Pillar can be alternatively soaked in dug underground water in case there is no pond, canal or river.
9. Lowest part of the pillar including six inches above the ground should be smeared/mixed with tar, thereby making it immune to worm-attack.
10. Similarly, it can also be kept immune to worm-attack if lowest part of the pillar including six inches above the ground is made brown through baking in fire.
11. Pillar base should be a little below its joint.
12. Bamboo pillar lasts 10-15 years, if it is set over wood-wedge.
13. Nails should be penetrated into bamboo pillar with the help of awl; otherwise if done by hammer, bamboo might develop crack/fissure.

Picture 67: Specimen of seasoning	Picture 68: Specimen of tar mixture

Picture 69: Specimen of wood-wedge	Picture 70: Mature bamboo

Cost

Estimated cost of a Pillar measuring 09'-12' feet long and 03"-04" inch dia would be BDT 200.00; accordingly, 16 pillars set every three feet to cover a house measuring 18' feet length and 10' feet breadth, plus four pillars in balcony, would thus cost **BDT4,000.00**.

Advantages

1. Bamboo pillar is available almost everywhere in Bangladesh.
2. It is less costly.
3. House owner can prepare bamboo pillar all by himself.
4. Mature and seasoned bamboo lasts 4-5 years.
5. Bamboo pillar lasts 10-15 years, if it is set over concrete-wedge.
6. Better part of the bamboo can be used afresh.

Disadvantages

1. Pillar succumbs to worm-attack if mature bamboo is not available or if not seasoned.
2. Underground part of the Bamboo gets decayed/decomposed fast

Maintenance

Maintenance is hardly required; it is however advisable to ensure that pillar is in rare contact with clay and water.

Wooden Pillar

Product of Bangladesh, local materials, custom/practice, affordability, etc., dictate common use of wooden pillar to construct earthen house in the country. Use of wooden pillar is however comparatively rife in the hilly area.

Detail Characteristic

Pillar of the house generally measures 9' to 12' feet long with 4" x 4' inch Dia. Dia may be 3" x 3' inch in case of round shaped pillar. Length and size of the balcony pillar is shorter in view of the height of the house.

Construction Strategy

1. Mature wood should be used for a pillar.
2. The Pillar has to be dug at least 1'-6" feet inside the foundation/base (using a Spud/Paddle utilized by Bangladesh Rural Electrification Board, if necessary). The hole has later to be compacted with hard clay, sand, brickbats, stone-chips, etc. so as to avoid any movement of the pillar.
3. Pillar has to be dug vertically through plumb-line, so that it does not bend.
4. Groove/sheath has to be carved atop the pillar so as to well fasten the roof/pyre to the pillar.
5. Pillar wood has to be immersed under water at least for three weeks, to be dried up next for seven days; this will keep pillar immune to worm-attack and enhance its longevity.
6. Wooden pillar lasts 20-25 years, if it is set over concrete-wedge.
7. It remains immune to worm-attack if lowest part of the pillar including six inches above the ground is made brown through baking in fire.

Cost

One wooden pillar measuring 09'-12' feet long with 02"-03" inch dia would cost BDT 1,000.00; accordingly, 16 pillars planted every three feet to cover a house measuring 18' feet long and 09' feet wide, plus four pillars in balcony, would cost **BDT20.000.00.**

Advantages

1. Mature and seasoned wooden pillar lasts at least 10-12 years
2. Wooden pillar lasts 20-25 years, if it is planted over concrete-wedge.
3. Despite damage in the lower part, better portion of the pillar can be recycled.
4. Expansion of the house and pillar repair is simple.

Disadvantages

1. Comparatively costly.
2. Unseasoned and immature wood is susceptible to worm-attack.
3. Underground portion of the pillar tends to decompose/rot fast.

Maintenance

Maintenance is hardly required; it is however advisable to ensure that pillar is in rare contact with clay and water.

Comparative Cost Analysis of Bamboo Pillar, Wooden Pillar and Bamboo-cum-RC Pillar

Bamboo Pillar

Bamboo Pillar Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Bamboo Pillar for the main Dwelling (11'x3")	16 Ea	200.00	3,200.00
Bamboo Pillar for Balcony (11'x3")	04 Ea	200.00	800.00
		Grand Total	**4,000.00**

Wooden Pillar

Bamboo Pillar Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wooden Pillar for the main Dwelling (11'x4"x4")	16 Ea	1,000.00	16,000.00
Wooden Pillar for Balcony (9'x4"x4")	04 Ea	1,000.00	4,000.00
		Grand Total	**20,000.00**

Bamboo-cum-RC Pillar

Bamboo Pillar Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
RC Pillar for the main Dwelling (12'x4"x4")	08 Ea	1,700	13,600.00
Bamboo Pillar for the main Dwelling (11'x3")	10 Ea	200	2,000.00
RC Pillar for Balcony (10'x4"x4")	04 Ea	1,400.00	5,600.00
		Grand Total	**21,200.00**

Session V
Subject: House Fencing
(Fifth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about different types of Fence. 2. To explain and distinguish between CI Sheet Fencing and Bamboo Fencing as well as their respective advantages and disadvantages . 3. To describe the technology to be applied and materials to be utilized for sustainable but low-cost CI Sheet Fencing and Bamboo Fencing. 4. To explain the disaster risk reduction points/issues to be considered in respect of CI Sheet Fencing and Bamboo Fencing and inform others accordingly. 5. To reflect on the strategy to care and maintain CI Sheet Fencing and Bamboo Fencing.
Time	70 Minutes
Methodology	Lecture, Discussion, Group Discussion, Question-Answer, , Picture/Sample/Model display
Materials	Multi-Media (if available), Fence Specimen/Model, Board, Poster Paper, Marker, Pen & Writing Book, Handout, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will discuss about the fence, its necessity and importance. 2. S/he will reflect on the various types of fence common in different places with the help of multi-media, model/picture display, etc. 3. S/he will undertake discussion through question-answer about fence making strategy common in a particular area. 4. S/he will involve the participants in discussion on respective advantages and disadvantages of CI Sheet fencing and bamboo fencing.
	Step-III:Time-20 Minutes 1. Facilitator will undertake discussion through question-answer on the construction strategy of earthen wall prevalent in the area. 2. Following the update on the problems around fencing, s/he will share with the participants the reasons behind the identified problems and ways to solution thereof. 3. S/he will later reflect on, and share with them about, disaster-friendly strategy available from the Caritas-implemented pilot project with the help of multi-media, picture/model display, etc.
	Step-IV:Time-10 Minutes Facilitator will apprise the participants in the light of handout or with the display of picture/model which matters/issues need to be considered to reduce disaster risk around fencing

Session Conduction Process (Contd.)	**Step-V:Time-10 Minutes** Facilitator will seek participants idea/knowledge of the following as part of evaluation process through question-answer: 1. What is a disaster-friendly house? What are the advantages and disadvantages of the fence meant for such a house? 2. What kinds of sustainable technology are applicable to preparing fence in the area? 3. What materials/ingredients are required to ensure more sustainable fence? 4. What matters/issues are relevant for consideration around disaster risk reduction while preparing a fence? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Fence)

Wall/Fence

Wall/Fence covers the house from all sides as well as the area in-between the floor and the ceiling. Wall or fence of a house ensures safety and privacy of the life and property of the insiders. We come across various types of wall and fence based on custom/practice in the area and materials/ingredients available there; like, bamboo fence, CI sheet fence, CI sheet -cum-bamboo fence, wooden fence, fence made out of jute stick, fence made out of *Ekore* (a local variety of sun-grass), fence made out of straw (a country ingredient), fence made out of *Tati* (a country ingredient), earthen wall, brick wall, etc. A house is again subdivided in the form of rooms by way of partition wall or fencing partition.

Bamboo Fence

Characteristic Detail

1. A mature *Mulee* Bamboo (a local variety) needs to be divided into two parts for the purpose of Fence.
2. Back part of the mature *Mulee* bamboo is utilized for outside fence of the house and front part is meant for partition fence. This bamboo can also be used in preparing the front side fence of the house to accommodate balcony.
3. Fence is to be modeled on the measurement of the house.
4. Fence made of mature bamboo is tied by string/thin nylon rope/thin plastic rope at one foot interlude with provision of at least one inch width knot on both the sides.
5. There can be two or three parts of a house fence: CI sheet can form the bottom part of the fence from floor to lower tip of the window measuring 2'- 6" feet in height, the middle part comprising the area from the bottom part of the window to the top of the door might be made of bamboo and the remaining part towards the top can be made of thin bamboo splits.

Construction Strategy

1. Seasoned bamboo has to be utilized. For that purpose, bamboo has to be submerged in water for 21 days and dried later for seven days in the sun prior to use.
2. Three-pronged/two-pronged splits of mature bamboo have to be tight-fastened according to the size of the house.
3. Coarse bamboo mat fence is to be prepared and suitably tight-fastened according to the size of the house (in the light of the picture).
4. CI sheet fencing at the bottom is to be set inward of the house and bamboo fencing at the upper part is to be placed outward.
5. Corners of the fence are to be suitably tied and bamboo laths or old tyre have to be placed at corner-joints; this will ensure sound fencing knots and people will feel safe against any odds.
6. Rows of bricks/long wood/long bamboo are to be used at the bottom of the lower part of the fence; wooden frame might be used, if necessary.

7. Fence is to be tied to each pillar of the house using wire/nylon rope/plastic rope.
8. Tin fencing of 22-24mm thickness is to be used at the lower part of the fence.
9. 1” thick x 2” width wooden batten has to be used vertically for tin fencing.
10. Batten has to be nailed every two feet. In case of fence, it has to be nailed below CI sheet’s wave point; CI sheet’s forepart has to be aligned with batten.
11. Tar/paint should be applied to the lower portion of the CI sheet-fence; colour CI sheet can alternatively be used. This will protect the lower portion of the fence from early damage owing to rain water and contact with soil.

Pictures depicting issues/matters relevant to preparing Fence

Picture 71: Use of seasoned bamboo is a valid deterrent against worm-attack. For that purpose, bamboo has to be submerged in water for 21 days and dried later for 07 days in the sun prior to use

Picture 72: Three-pronged / two-pronged fence out of mature bamboo splits

Picture 73: Coarse bamboo mat fence to be prepared to make for tight-fastened fence

Picture 74: CI Sheet fencing at the bottom is to be set inward of the house and bamboo fencing at the upper part is to be placed outward, so as to avoid rain-water inside

Pictures depicting issues/matters relevant to preparing Fence

Pictures 75 & 76: Corners of the fence are to be suitably tied and bamboo laths or old tyres have to be placed at corner-joints; this will ensure effectiveness of fencing knots and people will feel safe against any odds.

Picture 77: Placement of rows of bricks / long wood / long bamboo at the bottom of the lower part of the fence will by and large keep the CI sheet rust-free	Picture 78: Application of tar at the lower portion of the CI sheet-fence will protect the lower portion of the fence from early damage owing to rain water and/or contact with soil

Partition

Partition separates two rooms of the house by wall or fence. Partition provides for maintenance of privacy. It is indispensable from gender perspective as well as for children's education.

Partition results from one or more of the following: bamboo fence, tin fence, jute stick fence, *Ekore* fence, straw fence,*Tati* fence, brick wall. wooden fence, earthen wall, etc.

Comparative Cost Analysis of House Wall and Fence prepared with various ingredients

House Fence from Bamboo and CI sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Bamboo Mat	168 Sft.	20.00	3,360.00
CI sheet –0.23 mm/8 Ft.	13 Ea	400.00	5,200.00
Wood (1.50"x1.00")	1.50	1,000.00	1,500.00
Artisan Wages	1	1,000.00	1,000.00
		Grand Total	**11,060.00**

House Fence from CI sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
CI sheet–0.23mm/8 Ft.	26 Ea	400.00	10,400.00
Wood (1.50"x1.00")	3	1,000.00	3,000.00
Artisan Wages	1	1,000.00	1,000.00
		Grand Total	**14,400.00**

House Fence from Brick and CI sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Brick, etc., Area	140 Sft.	100.00	14,000.00
CI sheet–0.23 mm/8 Ft.	13 Ea	400.00	5,200.00
Wood (1.50"x1.00")	1.50	1,000.00	1,500.00
Artisan Wages	1	1,000.00	1,000.00
		Grand Total	**21,700.00**

Session VI

Subject: Doors and Windows
(Sixth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about the importance of Doors and Windows. 2. To narrate about site selection and preparation strategy of Doors and Windows. 3. To describe about advantages, disadvantages and cost involving Doors and Windows. 4. To explain the disaster risk reduction points/issues to be considered in respect of Doors and Windows and inform others accordingly. 5. To describe how to maintain Doors and Windows.
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing and Picture/Sample/Model display of Doors and Windows.
Materials	Marker, Masking Tape, Pin, Brown Paper, Specimen/Picture of Doors and Windows, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 2. Facilitator will reflect on various types of doors and windows and their necessity and importance. 3. S/he will discuss about door and window making strategy, their utility and cost.
	Step-III:Time-15 Minutes Facilitator will reflect on disaster risk reduction strategy in respect of Doors and Windows and explain with the help of picture.
	Step-IV:Time-10 Minutes Facilitator will seek participants word on the following as part of evaluation process through question-answer: 1. What are the importance, advantages and disadvantages of the doors and windows? 2. What needs to be done to reduce disaster risk around doors and windows? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks.

Facilitator's Guide

(Doors and Windows)

Door

Door is required to enter in the house, facilitate adequate wind and light flow inside as well as ensure security and privacy of all. Local custom/practice and availability of ingredients determine the type, nature and shape of the door. Door consists of a door-frame and a door-shutter. Wooden door is common in average rural area; steel doors are being used now-a-days. Each house should have at least two doors.

Window

Window is indispensable to facilitate adequate wind and light inside. Sticks or grill are set in the window to refrain anybody from entering inside and prevent any theft; window panes/window-shutters are used to ensure privacy and shield against air, sunlight and rain water. Local custom/practice and availability of ingredients determine the type, nature and shape of the window. Wooden window is however common in average rural area. It is advisable to have at least two windows in a room to facilitate adequate and regular entry and exit of air and light.

Picture 79: One window needs to be placed opposite to another so as to facilitate adequate wind-flow

Characteristic Detail

1. Generally, one door is set in the front of the house and another in the rear or at the side; again, a connecting door is in place for the adjacent room.
2. Door height is generally 6'-7' feet and its breadth varies between 2'-6" feet to the 3' feet.
3. Cross-section of the door-frame assumes various measurement: 2"x 2.50" inch, 2"x 3" inch and 2.50"x3" inch.

4. Thickness of door-shutter is generally 1”x1.5” inch.
5. “Z” batten or panel door is common.
6. 3”-5” inch size hinges and 4”-6” inch size hook / shackles / ring are set in the door for its opening and closing.
7. One- or two-part door and window are used as per custom/practice in the area; people are accustomed to four-part window, too.
8. Window height is generally 3’-4’ feet and breadth 2’.06”-4’ feet or more; window is set 2’-6”- to 3’ feet above the plinth level.
9. Cross-section of window-frame assumes various sizes: 2”x1.5” inch in case of bamboo fence and 2”x2.5” inch or 2.5”x3” inch in case of earthen wall. Thickness of window panes is generally 1”-1.50” inch
10. 3” inch size hinges and 4” inch size hooks are used in the window. In addition, shackles/ring/wooden fastener/cramp is also used.
11. Variety of wood to be used depends on local availability. It must be *sari kath* (in local term), that is, wood possesing better kernel/substance

Construction Strategy

1. Seasoned timber of mature tree has to be used per local custom.
2. Doors and windows prepared by seasoned timber last almost five times more.
3. Doors and windows are treated with enamel paint for beautification and sustainability as well as to counter insect-attack and damage from water. Anointing with brownish oil at minimum cost adds to sustainability, too.
4. Shutters should be set inside the house
5. One window needs to be placed opposite to another so as to facilitate adequate wind-flow.
6. Additionally, windows should be placed in due consideration of the convenience of the neighbours / families living nearby.

Time-frame and Cost

Four days would be required to make out and set two doors and four windows in a house measuring 18’ feet long and 10’ feet wide; total cost would come to **BDT 15,000.00:** BDT 7,000.00 for doors and BDT 8,000.00 for windows.

Advantages

1. Adequate light and wind are available in the house and healthy environment prevails.
2. Security of life and property as well as insiders privacy is ensured.
3. Closure of door and window shutters in the winter ensures little cold.
4. Doors and windows prevent water surge inside the house during rains and storm.

Disadvantages

1. Doors and windows might be vulnerable to wood-louse attack.
2. Expansion and contraction of door and window shutters during winter and summer might obstruct smooth opening and closure thereof.

Maintenance

Time to time application of kerosene or turpentine oil to door-frames and window-frames and door/window shutters might prevent wood-louse attack.

Prompt repair of any danaged part of the window is advisable

Comparative Cost Analysis of House Doors and Windows prepared with various constituent ingredients

Door and Window made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door 2.50'x6.50' *Mehagony wood, thickness of door-shutter 1", door-frame 3"x2.50"	02 Ea	3,500.00	7,000.00
Window with Grill 3'x2.50' *Mehagony wood, thickness of window-shutter 0.75", window-frame 2"x2"	04 Ea	2,000.00	8,000.00
		Grand Total	**15,000.00**

*****Valuable tree providing for quality timber

Door and Window made of Steel

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door 2.50'x6.50' MS Steel thickness of door-shutter 22 Gauge, door-frame 1.50"x1.50" with MS angle 3mm	02 Ea	5,000.00	10,000.00
Window with Grill 3'x2.50' MS Steel thickness of window-shutter 22 Gauge, window-frame 0.75"x0.75", thickness of MS angle 2mm	04 Ea	2,000.00	8,000.00
		Grand Total	**18,000.00**

Door and Window made of CI Sheet and Wooden Frame

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door 2.50'x6.50', Tin door-shutter and wooden door-frame	02 Ea	1,650.00	3,300.00
Window 3'x2.50', Tin window-shutter and wooden window-frame	04 Ea	800.00	3,200.00
		Grand Total	**6,500.00**

Session VII

Subject: House Truss and Shed
(Seventh Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about house Truss and Shed and their preparing strategy 2. To narrate in sequence about the type and measurement of wood to prepare Truss and Shed. 3. To learn and describe about cost, sustainability and maintenance of easily and locally available wood. 4. To explain the disaster risk reduction aspects/issues to be considered in respect of preparing Truss and Shed and inform others accordingly.
Time	70 Minutes
Methodology	Lecture, Discussion, Question-Answer, Group Discussion and Picture/Sample/Model display.
Materials	Board, Multi-media, Handout, Poster Paper, Marker, Pen-Writing Pad, Cork Sheet, Wood-Bits, Nails, Hammer, Specimen/Model of Thatch.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will discuss about house truss and shed, their necessity and importance. 2. S/he will reflect on different types of truss and shed common in various areas through multi-media or picture or drawing on the board. 3. S/he will initiate participatory discussion on the utility of truss and shed. 4. S/he will then gradually engage in discussion on various houses we live in and their importance by way of picture display in multi-media; discussion will also cover the measurement of the shed of a strong and disaster-resilient house (bracing/wall plate/top tie). 5. Lastly, discussion will reflect on wood measurement in different parts of a disaster-resilient house, estimated cost of various measurements of wood as well as wood treatment and maintenance
	Step-III:Time-20 Minutes 1. Facilitator will resort to question-answer to discuss on the construction strategy of truss and shed as prevailing in the area. 2. After knowing the problems around the truss and shed, s/he will share the reasons behind such problems and way to solutions thereof 3. Later, s/he will share the disaster-friendly technology available from the Caritas-implemented pilot project by way of multi-media/picture/model.

Session Conduction Process (Contd.)	**Step-IV:Time-10 Minutes** Facilitator will reflect on disaster risk reduction strategy in respect of truss and shed and share the same with the participants with the help of picture/model.
	Step-V:Time-10 Minutes Facilitator will seek participants word on the following as part of evaluation process through question-answer: 1. What are the importance of truss and shed in house construction? 2. Where are the rafter, bracing, runner, wall plate, etc., used and what would be their respective measurement? 3. Which sustainable technology(ies) is/are relevant to truss and shed common in the area? 4. What materials/ingredients are required to enhance the sustainability of truss and shed? 5. What measures need to be considered for disaster risk reduction while preparing truss and shed? 6. What are the ways to maintain truss and shed incurring minimum cost? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks.

Facilitator's Guide

(House Truss and Shed)

Roof Truss

Some kind of sheet is placed on wall and/or pillars of a house to cover it; roof truss is the frame set on the wall/pillars for such covering. Shed is placed on the roof truss. Roof Truss or the shed is very indispensable and important for the house. Shed/Roof Truss might be made of bamboo, wood, iron angle, etc., based on landlord's financial capacity, local disaster perspective, local custom/practice, etc.

Vital Parts of Roof Truss

Wall Plate

Wall plate is placed on the main wall or the pillar of the house. Wall Plate keeps the roof truss/shed complete with tie-beam, rafter, bracing, etc., in tact as well as transfers the weight of the roof truss onto the wall or pillar.

Construction Strategy of the Wall Plate

1. Wall Plate must be formed of mature wood or bamboo.
2. Wall Plate size differs on account of the materials/ingredients used: 3"x2" inch for wood, 3" inch dia for bamboo, 1.5"x1.5"x0.125" inch for iron angle.
3. There should not be any joint in case of wood within 10' feet; and grooved lap joint needs to be used where the length is more than 10' feet.
4. In respect of earthen wall, the wall plate has to be dipped into 1.5 feet below through fastening with GI wire or nylon rope.
5. Where RC pillar matters, wall plate is to be tied tight with an extended rod on its top; or perforated wall plate is to be fitted tight with the pillar by nut and bolt placed on it.
6. In case of bamboo wall, wall plate has to be tied tight with the carved U-type groove atop the bamboo using GI wire or nylon rope.
7. As to brick wall, perforated wall plate is to be fitted tight with the pillar by nut and bolt placed on it
8. Additional or visible part of wire, rod, angle and nut-bolt has to be painted with anti-corrosive colour so as to combat/offset rust
9. Wood and bamboo have to be seasoned before use to make it sustainable and long lasting.
10. Brownish oil or kerosene oil or burnt Mobil is to be smeared with wood and bamboo as a measure to avoid insect-attack.
11. Anti-corrosive paint is to be used in respect of angle.

Picture 80: Strategy to prevent house shed from being blown away by strong wind

Cross Beam/Tie Beam

Cross-beams and Tie-beams are utilized to hold in safety the roof truss framed along with rafter and clamp/purlin for covering the house and also to transfer its weight onto the wall or pillar. They are also used to set the ceiling properly. In addition, cross-beam and tie-beam have a contributory role to retain the truss/shed in its designated location as well as to brave any twist or movement in the face of wind. King post or Queen post is placed on the cross-beam and tie-beam.

Construction Strategy of Cross-beam and Tie-beam

1. Cross-beam and Tie-beam are sourced from wood, bamboo and angle.
2. Wood or bamboo must be mature to make cross-beam and tie-beam.
3. Wood or bamboo has to be seasoned prior to use for the sake of longevity and sustainability.
4. Their size varies in view of the breadth of the house. Up to the breadth of 11' feet, cross-beam and tie-beam will be of minimum 5"x2" inch size for wood, at least 3" inch dia for bamboo and at least 1.5"x1.5"x0.125" inch for iron angle.
5. Where the breadth is between 11' feet and 13' feet, cross-beam and tie-beam will be of minimum 5"x3" inch size for wood, minimum 3" inch dia for bamboo and minimum 2"x2" inch for iron angle.
6. Avoidance of joints in cross-beam and tie-beam is advisable; lap joint is however suggested in case of compulsion/inevitability.
7. Their number is generally dependent on the total number of rafters.
8. In respect of wood, twisted nails are required to set cross-beams and tie-beams with the wall plate, and twisted nails would have to be screw-driven into the wall

plate and not beaten or thrashed. Resultantly, the tie will not be loosened or unfastened in the face of wind. Simple nails may be used in other points/places.

9. Brownish oil or Kerosene oil or burnt Mobil is to be smeared with wood and bamboo as a measure to avoid insect-attack.
10. Anti-corrosive paint is to be used in respect of angle.

Rafter

Rafter is set on the wall plate to place house covering and other parts on the latter. Roof truss/shed along with the clamp/purlin is built on the rafter. Avoidance of joints in making out rafter is indispensable.

Construction Strategy of Rafter

1. Rafter must be formed from mature wood or bamboo.
2. Rafter size varies in view of the breadth of the house. Up to the breadth of 11' feet, rafter will be of minimum 2"x2" inch size for wood, minimum 3" inch dia for bamboo and at least 1.5"x1.5"x0.125" inch for iron angle.
3. Where the breadth is between 11' feet and 13' feet, rafter will be of minimum 2.5"x2.5" inch size for wood, minimum 2.75" inch dia for bamboo and minimum 2"x2"x0.1875 inch for iron angle.
4. Where the house is within 11' feet breadth, top-tie has to be used to hold two rafters in safety and to contain excessive wind pressure. Size of the top-tie will have to be compatible to that of the clamp/purlin. Top tie has to be set at the confluence of two rafters and 1/3 (one-third) height distance of tie beam (above the meeting point of two rafters).
5. King Post is to be set if the breadth of the house exceeds 11' feet and Queen Post is to be set if the breadth of the house exceeds 13' feet; Size of the king post and queen post should be the same as rafter size.
6. Placement of rafter is dependent on its size: it is generally set every 2.5' feet.
7. Wood rafter and bamboo rafter may be alternatively placed as a measure to minimize cost
8. Four corner-rafters have to be in place in respect of four-sided roof truss/shed. Where the breadth of the house is 11' feet, two rafters each of the size 2.5"x2.5" inch minimum for wood and 1.5"x1.5"x0.1875 inch minimum for iron angle have to be fixed; and in case of the house having 11' to 13' feet breadth, two rafters each of the size 3"x3" inch minimum for wood and 2"x2"x0.1875 inch minimum for iron angle have to be fixed.
9. Rafter has to be fixed with wooden and bamboo wall plate using twisted nail; and twisted nails would have to be screw-driven into the wall plate and not beaten or thrashed; rafters have to be fastened at the same time with the wall plate through the hurricane strap. As a result, detachment of the both out of wind pressure will have scant possibility. Simple nails might be used in other points/locations.
10. At least two nails have to be inserted in any joint; one-nail joint will be very weak.
11. Wooden corner rafter is better to be used for bamboo rafter.
12. Where steel angle matters, rafter is to be fixed with wall plate through nut and bolt or welding.

13. And in respect of bamboo, rafter is to be fixed with wall plate through wire, nylon rope, rope, etc.
14. Anti-corrosive paint is to be applied to the visible/additional parts of the wire, rod, angle, nut and bolt, etc., so as to combat/offset rust.
15. Seasoned timber and bamboo have to be used to make for sustainable and long-lasting rafter.
16. Brownish oil or Kerosene oil or burnt Mobil is to be smeared with wood and bamboo as a measure to control insect-attack.
17. Anti-corrosive paint is to be applied in respect of angle.

Clamp/Purlin

Clamp/Purlin is set on the rafter to place the roof truss/shed of the house. House covering/shed is placed on the Clamp/Purlin. Wooden or angle clamp/purlin is generally used.

Construction Strategy of Clamp/Purlin

1. Clamp/Purlin is to be sourced from mature bamboo.
2. Wooden clamp/purlin is to be used for both wooden and bamboo rafter.
3. Clamp/Purlin size for wood and angle will be respectively minimum 2.5"x1" inch and 1.5"x1.5"x0.125" inch.
4. Size and number of clamps/purlins will depend on rafter's length and distance.
5. Seasoned timber has to be used to ensure sustainable and long-lasting clamp/purlin
6. Brownish oil or Kerosene oil or burnt Mobil is to be smeared with wood as a measure to avoid insect-attack.
7. Anti-corrosive paint is to be applied in respect of angle.

Comparative Cost Analysis relevant to framing House Truss and Shed

House Truss and Shed made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wood *(Mehogany, Rain-tree, Eucalyptus) size as per design	18 Cft.	850.00	15,300.00
Grand Total			**15,300.00**

House Truss and Shed made of MS Angle

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Ms Angle measuring (1.5"x1.5"x3" mm Dia)	275	65.00	17,875.00
		Grand Total	**17,875.00**

*Trees in Bangladesh and around providing quality timber

Session VIII

Subject: House Roof/Covering/Canopy
(Eighth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about house roof/covering and its importance. 2. To narrate the technique and strategy of framing a house roof/covering. 3. To reflect on the utility living under a disaster-friendly house roof/covering. 4. To describe clearly about the maintenance of a house roof/covering. 5. To explain the disaster risk reduction aspects/issues to be considered in respect of preparing a house roof/covering and inform others accordingly.
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Displaying the ingredients/materials for house roof/covering and Experience sharing.
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Nails, Ingredients/Materials for preparing a house roof/covering.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will attempt at a definition of house roof/covering, reflect on its various types, its importance, display the ingredients/materials required to prepare a house roof/covering as well as its cost. 2. S/he will narrate the strategies of setting a house roof/covering and practically demonstrate these with the help of a pictures. 3. Lastly, s/he will deal with the utility of the house roof/covering.
	Step-III:Time-15 Minutes Facilitator will resort to practical demonstration or picture display to narrate what aspects/issues are relevant to disaster risk reduction while preparing a house roof/covering.
	Step-IV:Time-10 Minutes Facilitator will seek participants word on the following as part of evaluation process through question-answer: 1. What is house roof/covering, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction while preparing house roof/covering? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants' clarity; then s/he will wrap up the session with vote of thanks.

Facilitator's Guide

(House Roof)

House Roof/Covering

House Roof/Covering is meant to act as a canopy over the house truss built on the wall or pillars. We find various kinds of house roof framed with different materials like dry straw, *chhawn pata* (local variety grass)/dry leaves, jute stick, bamboo splits, polythene, asbestos sheet, colour sheet, GI sheet, RC materials, etc. depending on: financial ability of the landlord, house type, local hazard perspective, local custom/practice, etc.

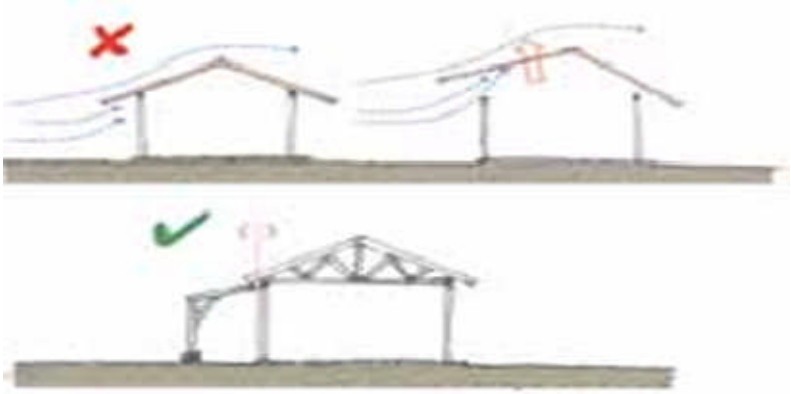
Construction Strategy

1. House Roof is formed with the materials like dry straw, *chhawn pata*/dry leaves, jute stick, bamboo splits, polythene, asbestos sheet, colour sheet, CI sheet, RC materials, etc., to act as a canopy covering the clamp/purlin of the house truss
2. ***House Roof formed with one or the other of dry straw, chhawn pata/dry leaves, jute stick, bamboo splits***: dry straw, *chhawn pata*/dry leaves, jute stick, bamboo splits, etc., have to be spread all over the clamp/purlin of the house truss and strongly tied with jute rope, nylon rope, plastic rope, bamboo cane, galvanized wire, etc.; later, there has to be another round of materials setting in the same way on the first line, sparing half or some part/area of the line (previous lining); full house truss will thus be covered in stages with house roof.
3. ***House Roof formed with polythene***: polythene sheet has to be spread all over the house truss (except clamp/purlin) and strongly tied with bamboo splits, jute rope, nylon rope, plastic rope, galvanized wire, etc., to cover the full house truss.
4. ***House Roof formed with colour sheet or CI sheet***: one line 1.5 wave lapping by colour sheet or CI sheet has to be completed over the clamp/purlin of the house truss and strongly tied with clamp/purlin using roofing screws or nails; later, at least 6" portion of upper part of the first line has to be filled-in, or otherwise lapped, and colour sheet or CI sheet is tied in the same way in the second round. Full house truss will thus be covered in stages with house roof. Upper meeting part at the four corners of the roof is to be linked/adjusted with ridging roofing screw to effect above.
5. Colour sheet or CI sheet is to be set properly with careful calculation/measurement at the four corners of the roof in case of four-side roof to complete house roof. The sheets have to be carefully handled while chopping, so that left-over part is not wasted away.
6. Anti-corrosive paint is to be applied to CI sheet to guard against any rust and enhance house roof longevity
7. Roofing screws have to be screw-driven, and not thrashed into, the colour sheet or CI sheet in all areas including the cyclone and storm belt. Nut has to be used along with washer; dented nails might also be tried. Part of the nail stretched/extended below the wood has to be bent.
8. In addition to Colour sheet or CI sheet, there has to be at least 1.5 wave lapping and one horizontal lapping of minimum 6" inch over another lapping
9. Rafter wood has to be extended 2" below from the terminal portion of Colour sheet or CI sheet (rafter top to be slopped from the sheet)

10. Each CI sheet must contain 03 (three) roofing screws/horizontal nailing; there has to be at least three-line roofing screw/nailing for 9' feet long sheet
11. House roof needs to be set at minimum 30-degree and maximum 40-degree angle as a measure to prevent the roof from being blown away in the face of wind
12. For the same reason, house roof should be four-sided rather than two-sided
13. House roof has to be strongly tied with the main house framework to avoid damage out of severe wind pressure
14. The less is the extended part of the house roof, possibility of wind-triggered damage is scant
15. All the constituting parts of the house roof have to be properly fixed / adjusted with the pillars. Roof is to be strongly fixed with ring beam utilizing galvanized nut-bolt, screw, nails and other metal frame. House roof rafter has to be directly fixed with ring beam through hurricane strap.
16. Two rafters at the top have to be fixed side by side using hurricane strap
17. CI sheet has to be strongly fixed using adequate number of galvanized roofing screws as well as dented iron as a measure of protection against wind
18. Balcony has to be separate from the main house, so that the latter is not damaged even if the balcony is blown away out of wind
19. Joints in the wood have to be strong and impregnable. Wood frame has to be properly anchored within the foundation through nut and bolt, so that frame is not de-linked from the base.

Pictures depicting issues/matters relevant to House Roof

Picture 81: House roof should be four-sided rather than two-sided as a measure to prevent the roof from being blown away in the face of wind (Sketch Credit: IFRC)

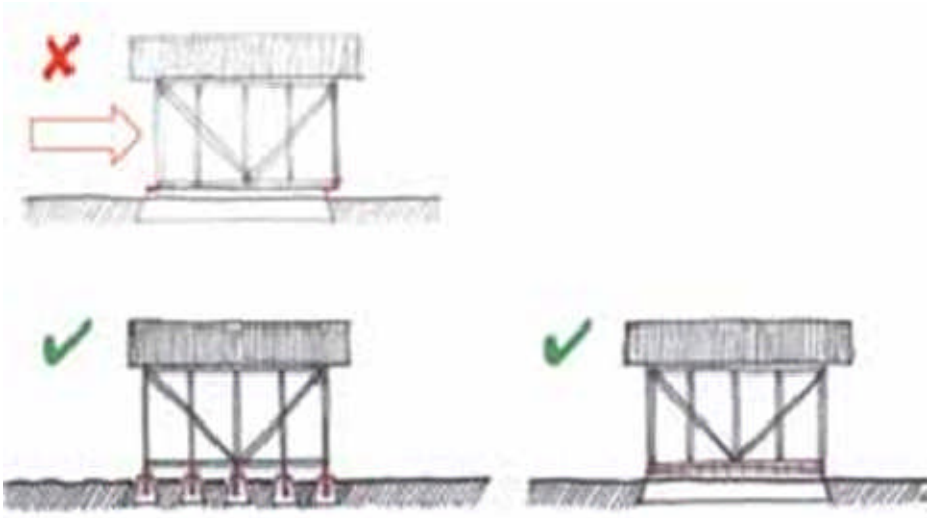


Picture 82: House roof has to be strongly tied with the main house framework to avoid damage whatsoever out of severe wind pressure (Sketch Credit: IFRC)

Picture 83: If the extended part of the house roof is between eight inch to one foot, possibility of wind-triggered damage is remote (Sketch Credit: IFRC)

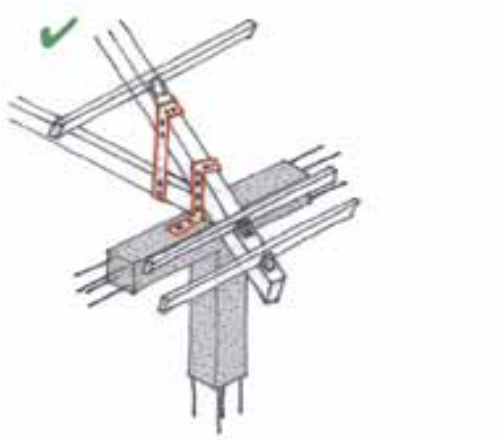
Pictures depicting issues/matters relevant to House Roof

Picture 84: House roof needs to be set at minimum 30-degree and maximum 40-degree angle as a measure to prevent the roof from being blown away in the face of wind (Sketch Credit: IFRC)

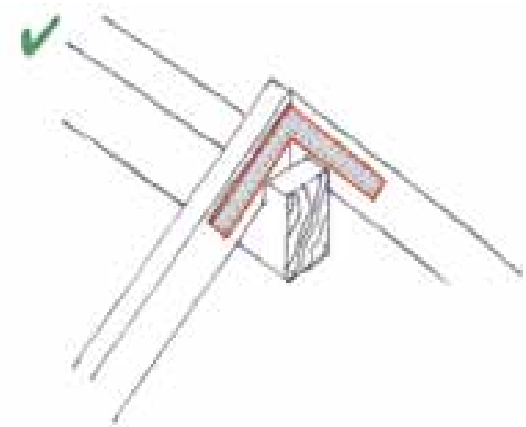


Picture 85: Joints in the wood have to be strong and impregnable; wood-frame has to be properly anchored within the foundation through nut and bolt, so that frame is not de-linked from the base. (Sketch Credit: IFRC)

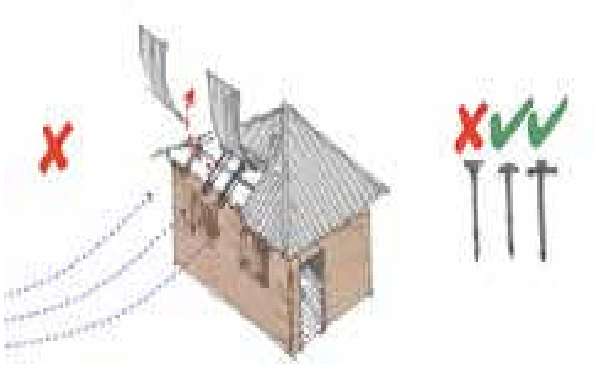
Pictures depicting issues/matters relevant to House Roof



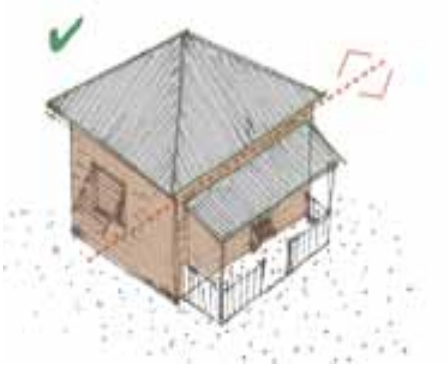
Picture 86: House roof rafter has to be directly fixed with ring beam through hurricane strap (Sketch Credit: IFRC)



Picture 87: Two rafters at the top have to be fixed side by side using hurricane strap (Sketch Credit: IFRC)



Picture 88: CI sheet has to be strongly fixed using adequate number of galvanized roofing screws as well as dented iron as a measure of protection against wind (Sketch Credit: IFRC)



Picture 89: Balcony has to be separate from the main house, so that the latter is not damaged even if the balcony is flown away out of wind (Sketch Credit: IFRC)

Estimated Cost of House Roof made of CI Sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
CI Sheet (320 mm)/8' with balcony	27 Ea	650.00	17,550.00
House Tua (local term) (260mm)/6'	10 Ea	200.00	2,000.00
Materials required for house roof fitting (screw, nails, rubber washer, nut-bolt, etc.)	Lump Sum	---	3,000.00
Fitting Charge including Truss	Lump Sum	---	7,000.00
		Grand Total	**29,550.00**

Session IX

Subject: House Bracing
(Ninth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define Bracing and reflect on its importance. 2. To narrate the technique and strategy of forming a Bracing. 3. To describe about the advantages, disadvantages and cost of Bracing. 4. To describe clearly about its maintenance. 5. To explain the disaster risk reduction aspects/issues to be considered while forming a Bracing and inform others accordingly.
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Display of Bracing model, Experience sharing, etc.
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Nails, Wood, Hammer, Saw, Bracing model, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-15 Minutes Facilitator will define bracing, and reflect on its importance, utility and construction strategy with the help/display of bracing model.
	Step-III:Time-20 Minutes Facilitator will resort to practical demonstration with model display to narrate what aspects/issues are relevant to disaster risk reduction while framing the bracing
	Step-IV:Time-10 Minutes Facilitator will seek participants perception of the following as part of evaluation process through question-answer: 1. What is bracing, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction in respect of bracing? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks.

Tip for the Facilitator

The Facilitator is required to consult various books, reports, updates, etc., relating to this topic apart from the module in order to gain clear concept of the subject matter; he might also try to collect any other relevant case-study to bolster his perception.

Facilitator's Guide

(House Bracing)

Cross Bracing

Cross Bracing is set with wood in a slanting direction between two pillars of the house. Cross bracing is effected by diagonally placing the wooden element across the two pillars dug in the two corners of the house according to the picture. Wood size in this respect would be 3"x2.5" inch. Thick and coarse rope or thin wire may also be used for cross bracing.

Bondage/linkage between two pillars resulting from cross bracing prevents any leaning or movement of the house in the face of storm or severe wind. Bracing has to be vertical, diagonal and corner-wise to fetch a firm wood-frame. In the same way, there has to be plenty of vertical, diagonal and corner-wise bracings to ensure a firm house fencing.

Estimated Cost of Cross Bracing

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wood 14' long and 5" dia	4 Ea	1,200.00	4,800.00
Bamboo 14' long and 3" dia	4 Ea	400.00	1,600.00
		Grand Total	**6,400.00**

Corner Bracing

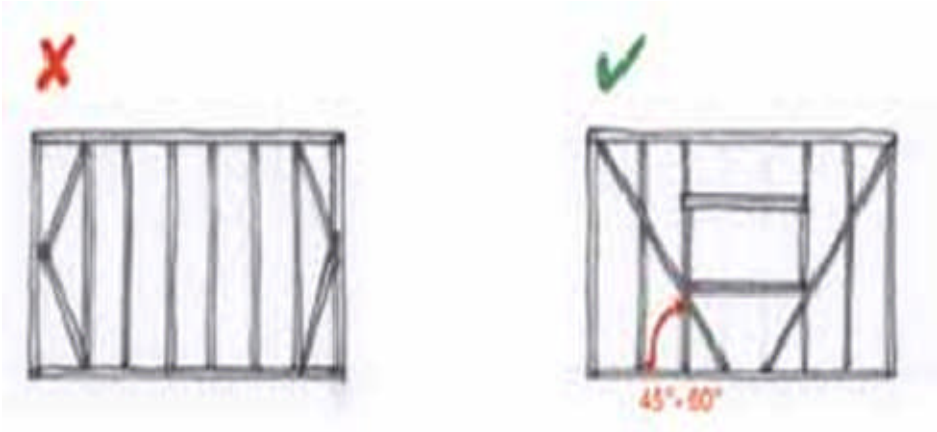
Corner Bracing is set along with wood in a slanting direction with the pillar and paiere on the upper part of the corner of the house. According to the picture, this is three feet long and attached with the corner pillar in 45-degree tri-angle position. Wood size for the corner bracing would be 3"x2.5" inch. It makes for bonding between the pillar and the house, obstructing any trend on the part of the house to lean and/or move in the face of wind or storm surge.

Estimated Cost of forming Corner Bracing

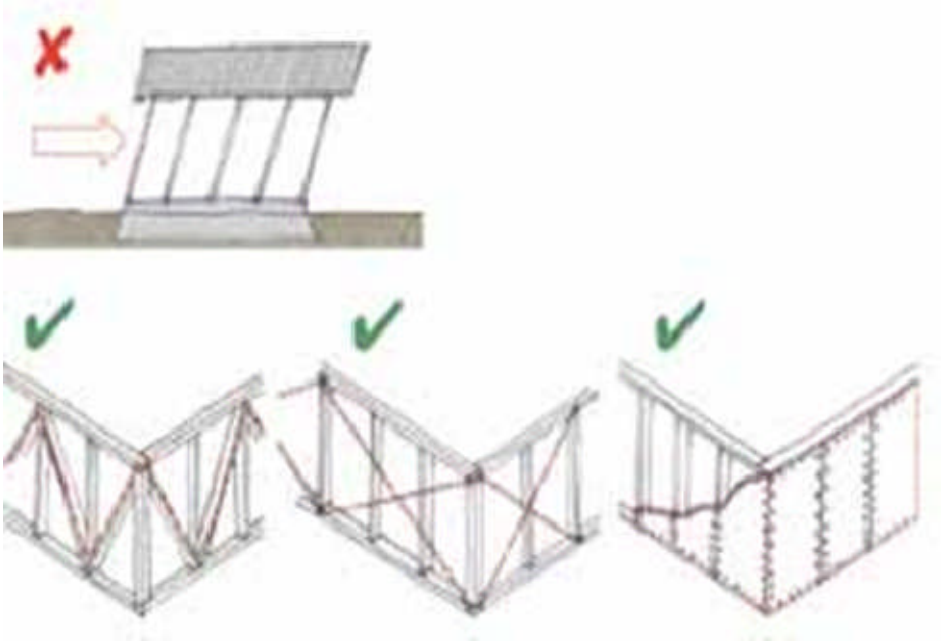
Corner Bracing made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Mehogony Wood 3'	1.2 Cft.	1,000.00	1,200.00
		Grand Total	**1,200.00**

Pictures depicting issues/matters relevant to House Bracing



Picture 90: There has to be properly set vertical, diagonal and corner-wise bracing to ensure a firm wood-frame (Sketch Credit: IFRC)



Picture 91: Plenty of vertical, diagonal and corner-wise bracings have to be set in the house fence to make it strong (Sketch Credit: IFRC)

Pictures depicting issues/matters relevant to House Bracing

Picture 92 & 93: Various types of Cross Bracing

Pictures depicting issues/matters relevant to House Bracing

Pictures. 94 & 95: Various types of Corner Bracing

Session X

Subject: House Ceiling
(Tenth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define Ceiling and describe its importance. 2. To narrate the technique and strategy of developing a Ceiling. 3. To describe about the advantages, disadvantages and cost of Ceiling. 4. To describe clearly about its maintenance 5. To explain the disaster risk reduction aspects/issues to be considered while developing a Ceiling and inform others accordingly.
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Display of Ceiling, Demonstrating Ceiling Materials, Experience sharing, etc.
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Ceiling Model, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will define ceiling, reflect on its importance and discuss about different types of ceiling. 2. S/he will refer to various materials required to constitute ceiling, show its formation strategy and describe the utility of house roof.
	Step-III:Time-15 Minutes Facilitator will resort to practical demonstration with model display to narrate what aspects/issues are relevant to disaster risk reduction while developing a ceiling.
	Step-IV:Time-10 Minutes Facilitator will seek participants view/pinion on the following as part of evaluation process through question-answer: 1. What is ceiling, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction in respect of ceiling? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Ceiling)

Ceiling

Ceiling forms an important part of the house which safeguards and shields the inmates from sunshine heat and winter cold; light household items can also be stored / preserved thereon, especially during flood. It beautifies house setting. Family members can also stay/live on the ceiling during flood, if it is hard, strong and high enough. Ceiling is generally made of bamboo splits and bamboo lath/clamp.

Picture 96: Ceiling made of Bamboo splits

Advantages and Disadvantages of a House Ceiling made of (i) Bamboo Splits and (ii) Wood

Ceiling Detail	Advantages	Disadvantages
Ceiling from Bamboo Splits	1. Skilled Artisan is not required 2. Locally available 3. Light valuable household items can be stored / preserved at the time of flood 4. Little time is required for its framing	1. Comparatively less strong or sustainable 2. Bulk/weighty items cannot be stored
Ceiling from Wood	1. Controls the room temperature (heat and cold) 2. Strong and long lasting 3. Valuable household items can be stored and temporary accommodation ensured at the time of flood	1`. Comparatively costly 2. Skilled Artisan is required 3. Comparatively much time is required for its formation

Comparative Cost Analysis to work out a Ceiling

Ceiling from Bamboo Splits
Ceiling for a house measuring 18' feet long and 10' feet wide would cost **BDT10,000.00**

Ceiling from Hard Board
Ceiling for a house measuring 18' feet long and 10' feet wide would cost **BDT16,000.00**

Ceiling from *Borga* and Bamboo
Ceiling for a house measuring 18' feet long and 10' feet wide would cost **BDT20,000.00**

Estimated Budget of a Disaster-resilient House

House Size (Four-sided Roof): 18'-00"x10'-6"x6'-00"

STEPS	1ST MODEL	2ND MODEL	3RD MODEL
First: **Layout**	600.00	600.00	600.00
Second: **Base/Foundation**	700.00	700.00	1,100.00
Third: **Plinth**	4,500.00	15,000.00	25,000.00
Fourth: **Pillar**	2,500.00	8,750.00	8,750.00
Fifth: **Fence**	14,000.00	20,000.00	21,600.00
Sixth: **Doors & Windows**	3,250.00	6,000.00	11,000.00
Seventh: **Truss/Shed**	16,000.00	16,000.00	24,000.00
Eighth: **Roof/Canopy**	25,050.00	25,050.00	25,050.00
Ninth: **Corner Bracing**	1,500.00	1,500.00	1,500.00
Tenth: **Ceiling**	10,000.00	10,000.00	16,000.00
Total Amount (BDT)	**78,100.00**	**103,600.00**	**134,600.00**

(Concluded)